KILMARTIN LOCAL AREA PLAN 2012-2018

Sustainable Urban Drainage System (SUDS) Strategy

OCTOBER 2012

DBFL Consulting Engineers

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APPENDICES

1.0 INTRODUCTION

1.1 Background

DBFL Consulting Engineers were commissioned by Fingal County Council to develop a Sustainable Urban Drainage System (SUDS) strategy for the proposed Kilmartin Local Area Plan (LAP) 2012-2018, in Tyrellstown, Dublin 15.

This new LAP will set out the local land use and planning policy for the Kilmartin area and provide an updated strategy on how the lands should be developed and managed in a sustainable way to meet the needs of its residents.

The objectives of this report are to inform the LAP process regarding the constraints, recommendations and requirements for a future SUDS scheme to be adopted in the development of lands within the LAP boundary.

2.1 Site Location and Description

The LAP lands, approximately 78.5 hectares (circa 194 acres), are located adjacent to Tyrellstown and to the north of Blanchardstown, see figure 1. They currently consist primarily of farmland which is drained by a system of drainage ditches. The existing R121 regional road (Church Road) cuts through the centre of the LAP lands and skirts its north-eastern boundary before connecting to the Ratoath Road.

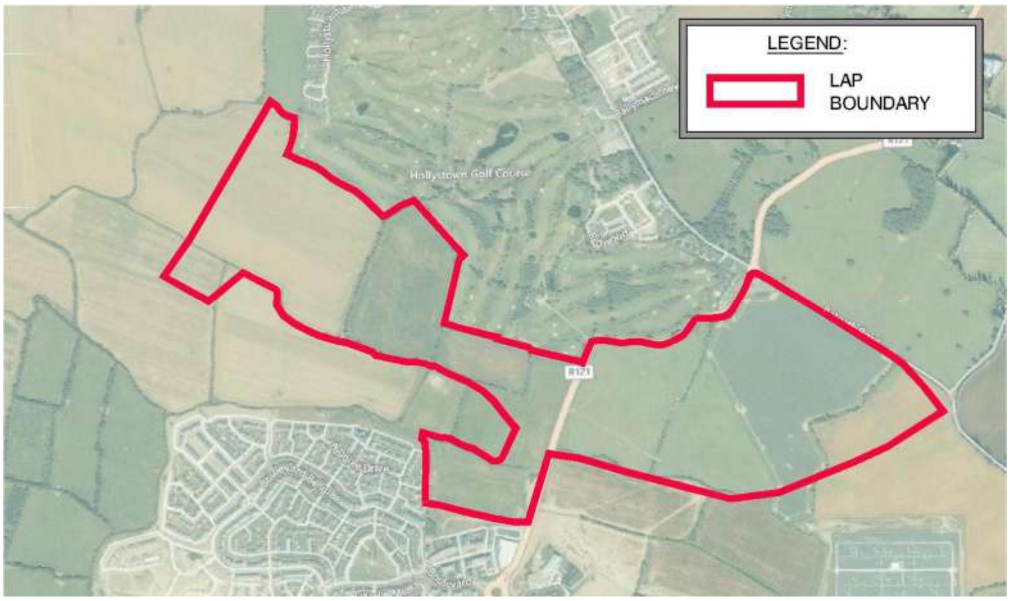


Figure 1 – Existing Site

3.1 Proposed Development

The Fingal County development Plan zones the Kilmartin LAP lands as the following categories;

- 'RA' zoned lands – "to provide for new residential communities in accordance with approved local area plans and subject to the provision of the necessary social and physical infrastructure".
- 'LC' zoned lands – "to protect, provide for and/or improve local centre facilities".

In total the LAP lands consist of the following:

- c.40.5 hectares of 'RA' zoned land east of the R121 and subject to 20 housing units per hectare restriction;
- c.32 hectares of 'RA' zoned land west of the R121;
- c.6.1 hectares of 'LC' zoned land north of the existing Tyrellstown local centre;

The Kilmartin LAP also includes the Hollywoodrath LAP which was adopted on the 13th November 2006 and relates to the lands to the east of the R121. There is also an extant permission on these lands (F07A/0973) for 331 residential units.

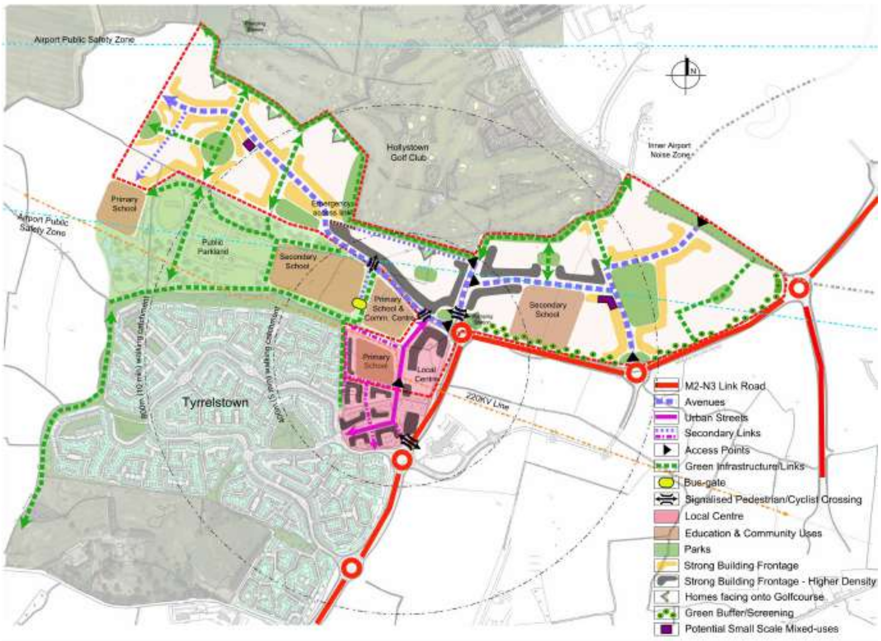


Figure 2 – Proposed Site

The R121 divides the zoned residential community lands (RA) lands into two parcels to the east and west. Residential areas will be divided into zones of differing housing density, a secondary school and parklands. Access to the lands will be provided from the existing Ratoath Road and the future N2/N3 Link Road currently under construction. New avenues, 'green infrastructure' links and Local Centre links will combine with the existing R121 to provide for pedestrian, cycle and vehicle access within the LAP lands.

2.0 DATA COLLATION, SURVEYS & AVAILABLE INFORMATION

A number of data sources were available for this report, these included the following;

- A strategic Environmental Assessment;
- An Appropriate Assessment Screening exercise;
- Topographic Surveys;
- Geological Survey Ireland (GSI) Online Mapping Information from www.gsi.ie website;
- Environmental Protection agency (EPA) Information Online Mapping Information from www.epa.ie website;
- Greater Dublin Strategic Drainage Survey (GDSDS);
- Fingal County Council Drainage Records.

In addition a site walkover/visual survey was conducted.

3.1 Topographic Survey

Contour and spot level information from three separate topographical surveys has been used to determine the extents of each contributing catchment for the Pinkeen River (East and West). The surveys were used to establish sub-catchment boundaries and ground slopes within each catchment and to determine areas contributing to drainage ditches which feed into each reach of the Pinkeen River.

The following topographical survey information has been used:

- Survey 1: 2m contour intervals, 44km^2 area, covers entire LAP lands and lands adjacent to the Pinkeen Rivers (East and West reaches);
- Survey 2: 0.5m contour intervals, 20.7km^2 area, covers entire LAP lands and lands adjacent to the Pinkeen Rivers (East and West reaches);
- Survey 3: Detailed survey at 50m grid, 2.4km^2 area, covers entire LAP lands, limited cover of lands adjacent to the Pinkeen Rivers (East and West reaches), detailed cross-sections of Pinkeen River and contributing ditches;

All topographical information was combined, see existing site survey in Appendix A, to facilitate mapping of the flood extents and flood zone categories.

3.2 Ground Conditions

No exploratory soil investigation was undertaken for this report, however a visual site inspection was carried out to examine and verify GSI and EPA data and soil maps.

The bedrock consists of Dinantian upper impure limestones or Dinantian mixed sandstones, shales and limestones, overlain by Limestone till (Carboniferous) or

Limestone sands and gravels (Carboniferous) in isolated places at the periphery of the site. The GSI maps show bedrock at the ground surface in some areas; however this was not confirmed by the visual site inspection. The EPA soil maps show that the surface soils/topsoils are primarily gleys (surface water gleys and ground water gleys), with isolated area of Grey Brown Podzolics / Brown Earths Basic and Mineral Alluvium in some watercourse areas, refer to figures 3, 4, 5, 6 and 7.

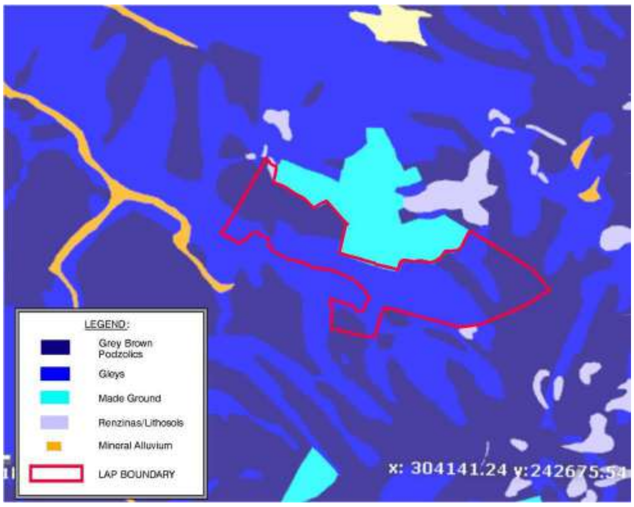


Figure 3 – GSI – EPA Topsoil Mapping

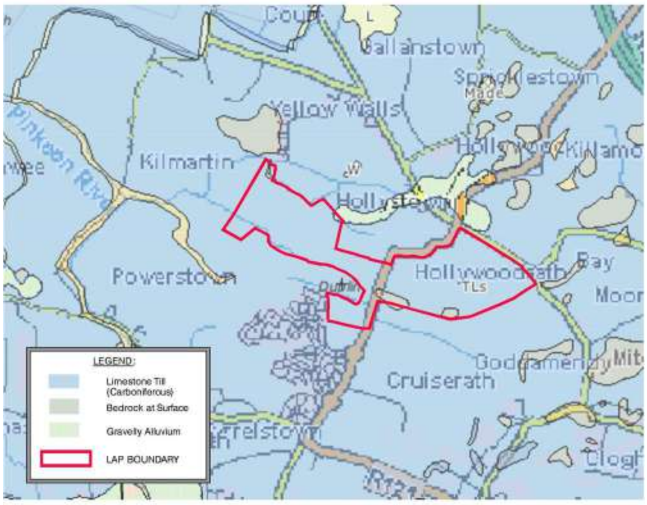


Figure 4 – GSI - Quaternary Mapping

Based on the above soil information, it is not expected that the glacial tills (boulder clay) will permit sufficient soakage of surface water into the subsoil, furthermore, according to GSI mapping, there are areas of the site overlying high to extreme vulnerability groundwater zones. Therefore SUDS infiltration features such as soak-aways or infiltration trenches may not be appropriate for the LAP lands.

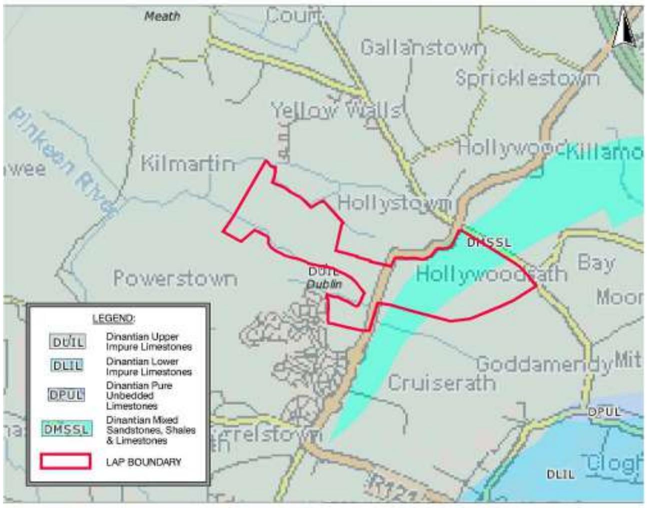


Figure 5 – GSI - Bedrock Mapping

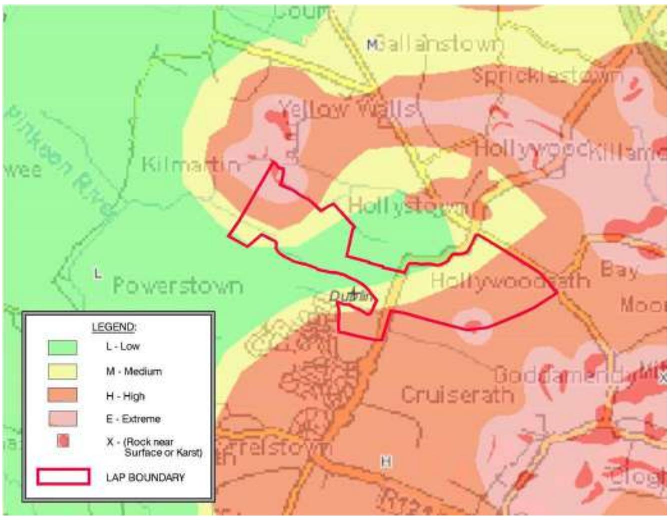


Figure 6 – GSI – Groundwater Vulnerability Mapping

Figure 7 – Subsoil Section (following removal of topsoil)

3.3 Existing Watercourses & Drainage Channels

The LAP lands consist primarily of farmland drained by a network of drainage ditches and watercourses which skirt the boundary of the fields. These ditches interconnect and ultimately discharge to the Pinkeen River to the west of the site.

A visual survey of the site was undertaken in September 2012 to assess the drainage function and capacity of the ditches. This survey also included a preliminary ecological assessment of the ditches and watercourses; a record is contained in Appendix B.

The majority of the drainage channels and ditches are combined with mature hedgerows and appear to be in good condition with thriving ecosystems. It is therefore recommended that the preservation and incorporation of these ditches into the LAP scheme should be maximised. Consequently, the drainage strategy for the LAP lands should aim to imitate the natural surface water flow regime as closely as possible by matching existing outfalls, rates and volumes.

3.4 Existing Surface Water Sewers

The existing Tyrellstown development to the south of the site contains a surface water sewer outfall which originates in the retail park distributor road to the east of the Carlton Hotel. This sewer traverses the northern and western boundaries of the district centre and residential development before discharging to the Pinkeen River via an attenuation wetland.

Although there is some spare capacity within this existing network for additional surface water flows, it is not sufficient to cater for all the attenuated flows from the LAP lands. Furthermore, as mentioned previously, it is the goal of this SUDS strategy to mimic the natural flow regime of the existing lands and maintain the existing ditches and watercourses as much as possible.

3.5 Climate Change

Climate change is acknowledged as taking place the world over, therefore, in accordance with the recommendations of the GDSDS climate change document, rainfall event depths should be increased by a factor of 10% in the design of new SuDS features. In addition, river flow rates should be increased by a factor of 20%, this should also apply to flows in watercourses and drainage ditches throughout the LAP lands.

4.0 PROPOSED SUDS STRATEGY

It is proposed to use a SUDS approach to storm-water management throughout the LAP lands. The proposed SUDS strategy will aim to provide an effective system to mitigate the adverse effects of urban stormwater runoff on the environment by reducing runoff rates, volumes and frequency, reducing pollutant concentrations in stormwater, contributing to amenity, aesthetics and biodiversity enhancement and allowing for the maximum collection of rainwater for re-use where possible.

Proposed SUDS features will aim to replicate the natural characteristics of rainfall runoff by providing control of run-off at source. SUDS are a requirement of Fingal County City Council under their 'Regional Code of Practice for Drainage Works' and the GDSDS. Additionally SUDS are mandatory under the new guidelines, 'The Planning System and Flood Risk Management' 2009.

As mentioned above, the overall objective of SuDS strategy is to minimise stormwater runoff from development where the purpose is to collect and treat this minimised amount of runoff as close to the source as possible.

The GDSDS and CIRIA Design Manuals C697 and C609 have been adopted to develop the SUDS strategy for the LAP lands. Accordingly, a stormwater management approach to treatment assures that both runoff quantity and quality are addressed through the techniques of:

- Pollution protection;
- Source control;
- Site control;
- Regional control.

These elements of the treatment train approach are discussed in the following sections and specific SUDS elements are detailed in Appendix C.

4.1 Pollution Protection

This stage of the treatment train aims to prevent chemicals and other pollutants from coming into contact with rainfall runoff which ultimately discharges to watercourses. The aim is to prevent potential damaging impacts rather than mitigating them.

The following preventative measures are proposed to prevent urban pollutant wash-off during rainfall events:

Structural Measures:

- *Physical structures or bunding should be constructed around above ground oil or chemical storage tanks in both domestic and commercial areas;*

- *Waste storage areas should be covered and contained by bunding, local grading or isolation from the drainage network;*
- *Vehicle washing or oil changing facilities should be contained by bunding, local grading or isolation from the drainage network;*
- *Grass filters strips should be provided at the edge of car-parks or carriageways where possible;*

Site Management Measures:

- *Site management measures may be implemented using education boards, literature, community meetings or consultation directly with commercial and domestic occupants.*
- *Commercial facilities should be encouraged to clean and sweep impermeable areas to prevent pollutant build-up;*
- *The use of chemicals on landscaped areas should be discouraged;*
- *Devise procedures to deal quickly with spillages of materials, preferably using dry techniques rather than wet techniques;*
- *Discourage car-washing, bin washing and disposal of liquid waste to the surface water network.*

4.2 Source Control

The purpose of source control is to detain or infiltrate surface water runoff as close as possible to the point or origin thereby reducing the peak runoff rate and ensuring that unavoidable pollutants are treated by natural methods. These natural treatment methods include filtering, evapotranspiration, infiltration, biodegradation and plant uptake.

The GDSDS requires source control should be provided for rainfall depths of 5mm such that no run-off should directly pass to the receiving watercourse, therefore a volume of interception should be provided at source to cater for this volume. The interception required is based on 5mm of rainfall depth from 80% of the runoff from impermeable areas.

As the existing soil conditions can only accommodate minimal infiltration, as discussed previously, alternative methods to remove this intercepted surface water volume need to be considered. The SUDS strategy for the LAP lands therefore recommends

- *Rainwater harvesting systems for commercial premises and water butts for every residential unit are provided within the LAP area.*

In addition, the SUDS schemes must utilise a volume of storage within each source control feature to allow long-term attenuation of rain water within the feature, for example through the use of porous material within the bio-retention areas. This would enable intercepted water to be delayed from flowing downstream until after storm events had subsided and ensure that it is discharged at such an insignificant rate that this water could be considered more likely as a 'base-flow' to the watercourse as would occur naturally. Alternatively or additionally, long-term infiltration or evaporation of these flows could be encouraged within the SuDS features, again this would occur after storm events had subsided.

This interception storage will be separate and additional to the site attenuation storage required and will allow long-term removal of run-off corresponding to the 5mm rainfall depth mentioned above.

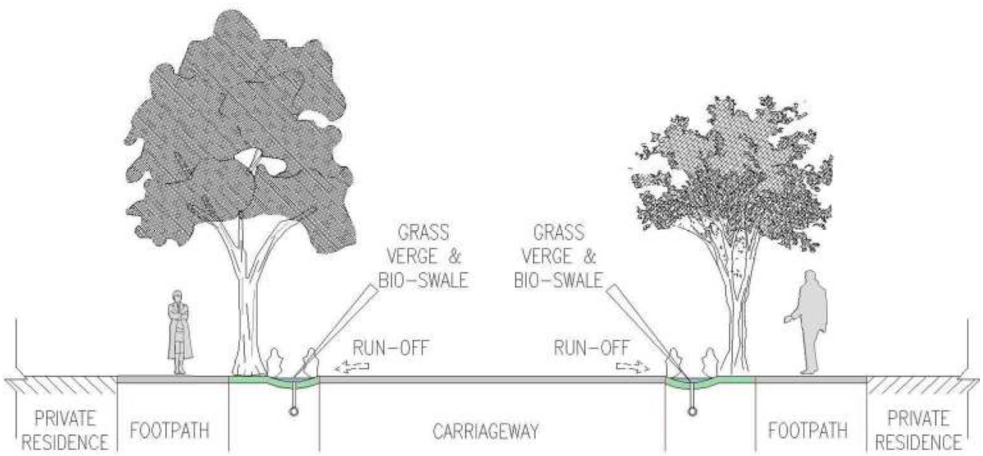
4.2.1 Source Control for Pedestrian and Vehicular Accesses

There are a number of varying vehicular and pedestrian access types and reservations proposed to be adopted in the LAP lands, each to suit their specific location, layout, zoning, aesthetics, traffic and pedestrian usage etc.

There are similarities between many of the infrastructure reservations which enable us to reduce the number to four distinct classifications of infrastructure cross-sections from a sustainable drainage perspective.

The locations where these SUDS cross-sections apply are shown in Appendix D and details of the SUDS features applicable to each cross-section classification are shown below.

SUDS Cross-Section 1:



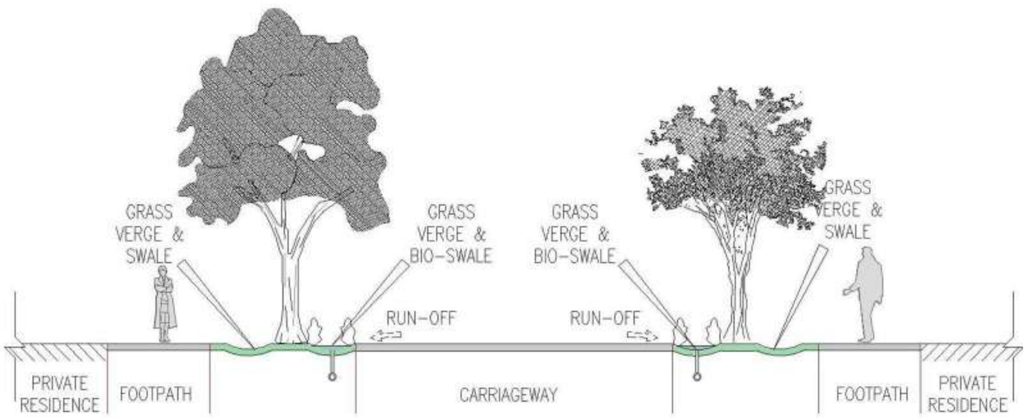
This SUDS drainage cross-section provides bio-retention swales (bio-swales) within planted verge areas adjacent to the road on each side. Bio-swales will be under-drained by filter drains and each section of bio-swale will be connected longitudinally along the length of the road to drain to an overall surface water collection and distribution system.

Surface water run-off from the surrounding road and paved areas will flow into the bio-swales as distributed 'sheet-flow' in locations where there is a low kerb or kerb which is flush with the adjacent road level. Alternatively, where full height kerbs are located along roads, run-off can be channelled through locally lowered points in the road kerbing where water can enter into the bio-swale channel in a controlled manner to avoid erosion.

In addition, local bio-retention areas will be provided within the larger sections of the road verge or in protruding traffic islands on an intermittent basis where possible. These bioretention areas will act as surface water 'catch-pits' where run-off can enter into the system by either 'sheet-flow' or channelization, as explained previously. The bioretention areas will also be under-drained by a filter drain which will enable each area to be connected to an overall surface water collection and distribution system.

- *SUDS cross-section 1 will apply to roads, avenues and streetscapes.*

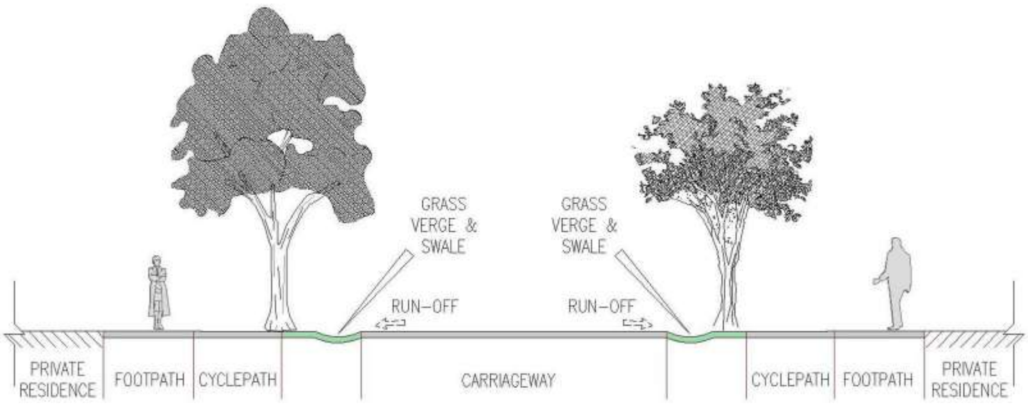
<u>SUDS Cross-Section 2:</u>



This SUDS cross-section includes road-side bio-swales and bioretention areas, as previously described. In addition however, where grass verge areas exceeding 1.5m in width are located adjacent to the road and do not include heavy planting, it is proposed that shallow grass 'swales' be located within these verges. These swales can be either wet swales or dry swales (swales which have a permeable topsoil surface and are under-drained by filter drains), each swale will contain a grated manhole 'catch-pit' at the outfall which will enable each section to be connected to an overall surface water collection and distribution system.

- *SUDS cross-section 2 will apply to roads, avenues and streetscapes.*

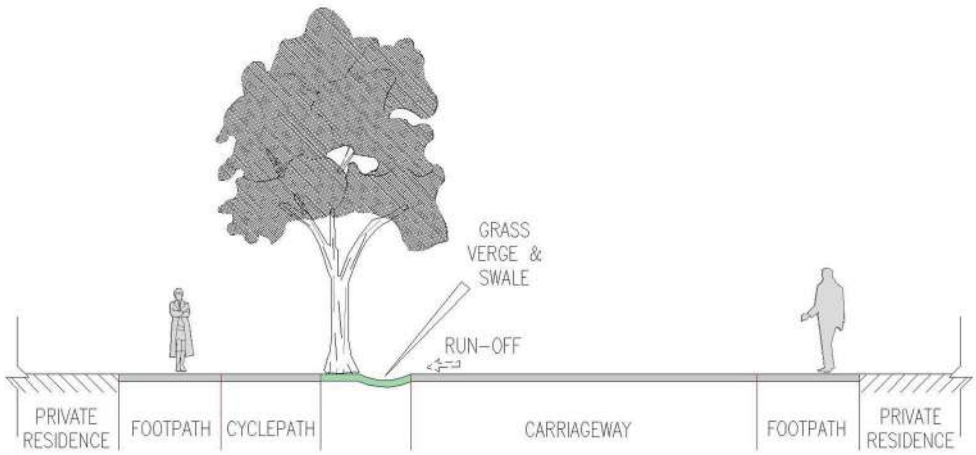
SUDS Cross-Section 3A:



This SUDs cross-section provides road-side grass swales (wet or dry) on both sides of the reservation where grass verge areas exceeding 1.5m in width. Each swale will contain a grated manhole 'catch-pit' at the outfall which will enable each section to be connected to an overall surface water collection and distribution system.

- *SUDS cross-section 3A applies to roads, avenues and streetscapes.*

SUDS Cross-Section 3B:



This SUDs cross-section provides a grass swale (wet or dry) on one side of footpaths and/or cycle-paths where a grass verge area exceeding 1.5m in width is adjacent. The swale will contain a grated manhole 'catch-pit' at its outfall which will enable each section to be connected to an overall surface water collection and distribution system.

- *SUDS cross-section 3B applies to pedestrian routes and cycle-paths on green links.*

4.2.2 Source Control for Residential Areas

Home-zones:

Home-zones will be drained by local bioretention areas which will be provided within the larger sections of verges or in protruding traffic islands where possible. These bioretention areas will act as surface water 'catch-pits' where run-off can enter into the system by either 'sheet-flow' or channelization, as explained previously. The bioretention areas will also be under-drained by a filter drain which will enable each area to be connected to an overall surface water collection and distribution system.

Local Road:

Local roads will be drained in accordance with the SUDS drainage cross-section which provides bio-retention swales (bio-swales) within planted verge areas adjacent to the road on each side, as previously described. Bio-swales will be under-drained by filter drains and each section of bio-swale will be connected longitudinally along the length of the road to drain to an overall surface water collection and distribution system.

Residential Units:

Each individual residential unit will be provided with a 'water butt' where roof water can be stored and re-used for landscaping or car-washing usage within the property. Roof downpipes at the rear of each unit will connect to a filter drain in the garden which in turn will connect to the drainage system at the front of the house.

The driveway of each unit will have a permeable surface and sub-base to which the drainage system from the rear garden and the roof downpipes from the front of the unit will be connected.

The filter drain and permeable pavement will enable water to be stored within the voids of their sub-bases before being slowly released through natural flow via the porous medium. These will result in a decrease in discharged run-off and an improvement in the quality of surface water draining from roofs of houses and paved areas and will also allow groundwater to recharge to its natural state.

The outfall from each individual residential unit will connect to an overall surface water collection and distribution system in the adjacent road or open space area, see typical layout in Appendix F.

4.2.3 Source Control for Commercial Areas

Buildings within commercial zones should include intensive or extensive green roofs on flat roof areas where no mechanical or electrical plant are located, where possible. Additionally, rainwater harvesting from roofs (excluding green roof areas) should be adopted for each commercial unit where rainwater can be collected in a tank to be stored and re-used for grey-water usage (toilets, washing machines etc.) or landscaping usage within the premises.

As there will be limited grass and planted areas within more densely developed and hard-landscaped commercial zones, the scope to provide 'green' sustainable drainage features on non-building areas is limited. Notwithstanding this, bioretention areas should be provided within the larger sections of verges or in protruding traffic islands where possible. The bioretention areas will be connected to an overall surface water collection and distribution system within the commercial zone.

4.2.4 Source Control for Educational Areas

Buildings within educational zones should include intensive or extensive green roofs on flat roof areas where no mechanical or electrical plant are located, where possible. Additionally, rainwater harvesting from roofs (excluding green roof areas) should be adopted where rainwater can be collected in a tank to be stored and re-used for grey-water usage (toilets, washing machines etc.) or landscaping usage within the site.

Within external areas, permeable pavements should be used on the majority of car-parking zones within the site. Access roads should be graded to drain to permeable pavements where they are located adjacent to parking. Alternatively roads and external paved areas should be drained by dry swales, filter drains or bioretention areas at low points to be connected to an overall surface water collection and distribution system within the educational zone.

On all cross-sections mentioned above, filter strips should be provided where possible between the roads and paved areas and the bio-swales, bioretention area or swales. These strips are wide, gently sloping areas of grass which treat runoff from hard-standing areas that pass over their surfaces before discharging to the adjacent swale etc.

The use of traditional road gullies as a drainage solution in the LAP lands is discouraged, however it is recognised that due to certain layout and level constraints it may be necessary to supplement the sustainable drainage system in that area with gullies. Where this is unavoidable and acceptable to Fingal County Council, all drainage runs which include run-off from road gullies should be routed through site controls such as proprietary approved silt traps systems and/or petrol interceptors.

4.3 Site Control

Site control comprises runoff and treatment installations to serve individual developments or sub-catchments or combinations of developments on adjacent sites.

Catchments

The R171 regional road splits the LAP lands into two distinct major surface water catchments to the east and west of the road. The LAP lands naturally slope from east to west towards the Pinkeen River, the eastern catchment slopes to north-west where its lowest is adjacent to the boundary with the R171. The western catchment's lowest point is located on the western extremity of the LAP lands near the Pinkeen River.

Due to the size of the LAP lands (78.5 hectares) and the length across it's catchment from west to east (2.1km), it is not physically possible to provide an overall attenuation facility for the entire LAP lands, nor would it be practical to collect all un-attenuated surface water throughout the LAP lands in a drainage system and discharge it to one attenuation system, the size and capacity of the pipes required in the collection system make this option preclusive.

Furthermore, to conform to SUDS principles mentioned previously, surface water should be collected and treated as close to source as possible, this would also maintain base-flows in existing ditches and watercourses which are to be retained for the development and to which attenuated surface water flows will be discharged. Therefore, the two main surface water catchments mentioned above will be divided further into 16 sub-catchments in total based on the site layout, zone types, densities, available open space (to locate attenuation and long-term storage facilities), site levels, phasing of development and the nearest available outfall.

Each sub-catchment and the proposed location of its site attenuation feature and outfall to a drainage system are shown on SUDS strategy drawing in appendix E.

The site control requirements for the LAP lands are discussed in the following sections:

Long Term Storage

In addition to limiting the runoff rate through attenuation, to comply with current legislation and design requirements it is necessary that runoff volume from the site is minimised in extreme events also. The objective is to match the runoff volume discharged to the downstream receiving watercourse after development to that which occurred prior to development. Where this run-off volume is contained by providing 'long-term storage', this has a direct effect on the permissible site discharge rate from the surface water attenuation system, as explained further forward.

Where there is adequate open space adjacent to site attenuation facilities, long-term storage should be provided for in a dry detention basin alongside. Excess water from these attenuation facilities would spill over to a locally depressed area during an extreme storm event only. The level of the overflow structure should be designed such that these basins only begin to function for extreme events in excess of 1 in 20 year return period, otherwise a long-term storage basin which does not satisfy this criteria should be re-considered.

Long-term storage areas will need no special infrastructure or planting and can function as normal open space areas on a day-to-day basis, however, it is vital that the area is not connected to the main drainage system and surface water should instead infiltrate into the underlying ground over a period of time. To avoid the area becoming boggy, a filter trench or blanket should be provided under ground.

- Long-term storage volumes should be designed in accordance with GDSDS.

Permissible Site Discharge

According to the GDSDS, the method used to determine peak flow rates for small green-field catchments, such as the LAP lands, is the UK '*Institute of Hydrology Report 124, Flood Estimation for small Catchments'*. This method calculates $QBAR_{rural}$ which is the mean annual flood flow from a rural catchment and is based on the Standard Average Annual Rainfall (SAAR) for the catchment, Soil index (from Flood Studies Report) and the area of the catchment.

Where long-term storage can be provided or is not necessary, surface water from a sub-catchment can be discharged at a higher value than $QBAR_{rural}$, this discharge rate ($QBAR_{growth}$) is dependent on the design return period and the corresponding growth factor from the GDSDS Table 6.6. However, if long-term storage cannot be provided in a sub-catchment the discharge rate from the catchment should be kept to $QBAR_{rural}$ or 2ls/ha, whichever is the greater.

The GDSDS requires that the 1, 30 year and 100 year return period post-development discharge rates match their respective pre-development rates, where long-term storage has been provided. This may require a complex control vortex flow control (e.g. Hydrobrake) system to be provided which would incorporate 3 flow controls, or alternatively overflow structures, weirs or varying pipe sizes, for example.

The GDSDS and vortex flow control manufacturers recommend that they have a minimum size of 75mm diameter for public controlled systems. However, vortex flow controls can be as small as 50mm diameter for private systems where a strict maintenance regime is in place to ensure they do not become blocked. Due to the average size of each sub-catchment exceeding 4.5 hectares, it is not expected that any vortex flow control orifice would be less than 50mm, however, if multiple attenuation facilities are provided within sub-catchments, to utilise open spaces areas upstream of the sub-catchment outfall, these controls should be investigated further and their inclusion would require specific approval.

Surface Water Attenuation

Each sub-catchment will provide a site attenuation system, and where possible a long-term storage basin should be provided adjacent.

Using the permissible site discharge for each sub-catchment (depending on whether long-term storage is provided) and the maximum rainfall data from Extreme Rainfall Return Period values produced by Met Eireann, the maximum flood volumes to be attenuated for the critical 1 in 100 year return period event should be calculated. As required under the GDSDS the data should be increased by a factor of 10% for climate change.

The extreme rainfall return period values for Tyrrelstown are as follows:

SAAR	=	780mm
Ratio M560/M52d	=	0.32
$M_5 60$	=	17.0mm

4.3.1 Site Control for Residential Areas

Surface water attenuation facilities, within the majority of residential areas, should consist of dry detention basins, with another adjacent dry detention basin for long-term storage purposes which would have no outfall to the downstream surface water collection and distribution system.

Surface water detention basins would normally consist of a dry, vegetated surface, depressed below the surrounding ground levels and would normally function for a different purpose such as open space, a playground or a sports field.

A landscaped retention pond could be substituted as an alternative site attenuation system in lieu of a detention basin where it is considered possible or warranted to include from a safety, security, aesthetic and amenity viewpoint. Furthermore, retention ponds must be adequately sited such that there is sufficient remaining usable open space within the adjacent zone.

It is suggested that retention ponds be located in the linear open space area along the eastern boundary of the eastern catchment and in open space areas along green infrastructure links.

Where it is not possible to provide either detention basins or retention ponds in a sub-catchment e.g. due to limited open space near its surface water outfall, it will be necessary to provide an underground attenuation facility in lieu which should take the form of a ‘tanked’ geo-cellular system. These proprietary modular block or arch structures temporarily store surface water flood volumes within their structure underground. They can provide flexibility in their overall configuration and layout (and level) and encourage silt deposition which can be removed via maintenance and inspection tunnels.

4.3.2 Site Control for Commercial Areas

Due to limited open space within commercial areas and the nature of the density and usage of these areas, it may not be possible to include dry detention basins or retention ponds as attenuation facilities. Alternatively it may be necessary to provide underground attenuation facilities in the form of 'tanked' geo-cellular systems, see typical layout in Appendix F.

As previously mentioned, these proprietary modular block or arch structures temporarily store surface water flood volumes within their structure underground and can provide flexibility in their overall configuration and layout (and level). These systems should be located under car-park and open spaces areas within these zones.

4.3.3 Site Control for Educational Areas

Due to limited open space within educational areas, the nature of the usage of these areas and safety concerns that discourages the storage of open water, it may not be possible to include dry detention basins or retention ponds as attenuation facilities in these zones. As per commercial areas, it is recommended that underground attenuation 'tanked' geo-cellular attenuation systems are provided which could be located under car-park and open spaces areas within these zones, see typical layout in Appendix F.

Underground geo-cellular attenuation systems or detention basins can be configured in either an on-line or off-line manner. Detention basins which act as part of a water quality treatment train should only be configured on-line as should retention pond systems.

Water Quality Treatment

It will be necessary that a 'treatment train' surface water runoff management system is provided in each sub-catchment to accommodate a "treatment volume" (Vt) to prevent any pollutants or sediments discharging into river or watercourse systems.

According to CIRIA document C697 the following treatment train approach for each sub-catchment will be necessary:

- Roofs – 1 Treatment Stage
- Roads and Parking Areas – 2 Treatment Stages
- Paved Areas excluding Roads - 1 Treatment Stage
- Loading Areas and Refuse Areas – 3 Treatment Stages

Table 1 below outlines how a successful water quality treatment train will be achieved for each sub-catchment type within the LAP.

Zone	Sub-Catchment Type	Number of Treatment Stages Required	Source Control	Site Control System	Additional Treatment
Residential	Roofs	1	Water Butts; Filter Drains; Permeable Paving	Retention Pond	Not Required
	Roads and Parking Areas	2	Bio-swales; Bioretention Areas; Swales	Retention Pond	Not Required
	Paved Areas excluding Roads	1	Bio-swales; Bioretention Areas; Swales	Retention Pond	Not Required
Residential	Roofs	1	Water Butts; Filter Drains; Permeable Paving	Detention Basin	Not Required
	Roads and Parking Areas	2	Bio-swales; Bioretention Areas; Swales	Detention Basin	Not Required
	Paved Areas excluding Roads	1	Bio-swales; Bioretention Areas; Swales	Detention Basin	Not Required
Residential	Roofs	1	Water Butts; Filter Drains; Permeable Paving	Geo-cellular system	Not Required
	Roads and Parking Areas	2	Bio-swales; Bioretention Areas; Swales	Geo-cellular system	Silt Trap; Petrol Interceptor
	Paved Areas excluding Roads	1	Bio-swales; Bioretention Areas; Swales	Geo-cellular system	Not Required

Zone	Sub-Catchment Type	Number of Treatment Stages Required	Source Control	Site Control System	Additional Treatment
Commercial	Roofs	1	Green Roofs; Rainwater Harvesting	Geo-cellular system	Not Required (where green roof or rainwater harvesting provided); Silt Trap; Petrol Interceptor
	Roads and Parking Areas	2	Bio-swales; Bioretention Areas	Geo-cellular system	Silt Trap; Petrol Interceptor; (Both required where green roof or rainwater harvesting not provided)
	Paved Areas excluding Roads	1	Bio-swales; Bioretention Areas	Geo-cellular system	Not Required (where green roof or rainwater harvesting provided); Silt Trap; Petrol Interceptor
	Loading Areas & Refuse Areas*	3	Bio-swales; Bioretention Areas; Bunding; Silt Trap	Geo-cellular system	Silt Trap and Petrol Interceptor
Educational	Roofs	1	Green Roofs; Rainwater Harvesting	Geo-cellular system	Not Required (where green roof or rainwater harvesting provided); Silt Trap; Petrol Interceptor
	Roads and Parking Areas	2	Permeable paving; dry swales; filter drains; bioretention areas	Geo-cellular system	Silt Trap and Petrol Interceptor
	Paved Areas excluding Roads	1	Permeable paving; dry swales; filter drains; bioretention areas	Geo-cellular system	Not Required

Table 1 – Sub-catchment Treatment Train

* Additional treatment may be required where bio-swales or bio-retention areas cannot be included locally.

4.4 Regional Control

Regional control is the final element in the SuDS management train which provides control and treatment of surface water runoff on a catchment scale.

The proposed layout of the LAP lands does not cater for a regional control system within the boundary of the LAP, however, the large area of public parkland located adjacent to the boundary to the west and immediate south may provide an appropriate location for a regional retention pond or wetland system. These final features in the management train could provide a polishing treatment to surface water before it discharges to the adjacent Pinkeen River. Furthermore, a regional wetland or retention pond system could provide an attenuation function for the LAP lands which in turn would enable each site attenuation control within the LAP sub-catchments to be reduced in volume and footprint.

A regional attenuation system would greatly add to the amenity value of the parkland in this area.

5.0 SURFACE WATER DRAINAGE

5.1 Outfall to Surface Water Network

The existing surface water sewer outfall, which traverses the northern and western boundaries of the district centre and residential development before discharging to the Pinkeen River via an attenuation wetland, only has limited spare capacity. Therefore it is proposed that only attenuated discharge from the local centre zone, adjacent to the existing district centre, will discharge to this existing surface water sewer. The remainder of the sub-catchments will outfall to existing ditches or watercourses either directly or through new surface water outfall sewers.

As mentioned previously, each source control SUDS feature will be connected to piped surface water collection and distribution systems to be routed through the site control system for that sub-catchment where attenuated surface water flows will be discharged to the relevant outfall.

Refer to SUDS strategy drawing in appendix E for proposed outfall locations and the location of the existing Tyrellstown surface water sewer.

5.2 Overland Flow

Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. It occurs in urbanised areas where the surface water system is over capacity, blocked or the volume of runoff is too big to be able enter the system. Urban overland flow is usually associated with high intensity, short duration storm events such as that which occurred in the summer of 2008 in Dublin County.

Overland flood water flows across the ground surface following slopes and levels resulting in ponding in natural hollows and low-lying areas or behind obstructions before eventually entering a piped or natural drainage system.

Site levels, layout and location of open spaces and the gradients of roads and potential flood routes within the LAP lands should be designed such that overland flow is diverted away from properties and infrastructure to open spaces areas or zones and receptors of least importance.

Refer to SUDS strategy drawing in appendix E for proposed overland flood routes and inundation areas.

6.0 SUDS SELECTION DESIGN CONSIDERATIONS

6.1 SUDS Amenity

SUDS features should be designed to replicate a natural environment with a visual appeal, promote both public and wildlife usage and promote biodiversity within urban environments. In addition, SuDS features should aim to use water as a resource where possible.

6.2 SUDS Maintenance

SUDS features proposed for the site should be designed to minimise maintenance and repairs during their design life. As a guide, the SuDS features proposed will require the following general maintenance:

Filter Strips: Remove litter and debris regularly, grass should be cut and vegetation managed as required.

Filter Drains: Check for evidence of ponding above the infiltration surface. Manholes should be inspected for silting, blockages, clogging, standing water and structural damage half yearly and cleaned when required. If damage to pipes is suspected, a CCTV survey should be undertaken to locate damage. Trim or remove tree roots from manholes and pipes which may cause blockages. Replace geotextiles and clean and replace filter media if clogging occurs.

Swales: Provide adequate access around all swales for maintenance purposes. Remove litter and debris as required. Swales will require regular mowing and inspection of vegetation and the removal of sediment, nuisance or dead plants and re-plant as necessary. Grass should be cut monthly during the growing season and erosion at the inlet/outlet should be repaired as required. Re-level uneven surfaces and scarify and spike topsoil layer to improve infiltration on dry swales.

Permeable Surfacing: Regular brushing and removal of leaves, removal of weeds as necessary. Stabilise and mow contributing and adjacent landscaped areas regularly. Repair any depressions, rutting, cracked or broken blocks considered detrimental to the structural performance or a hazard to users.

Landscaped Retention Ponds: Remove litter and gross pollutants as required. Inspect pond edge vegetation and remove nuisance plants as required. Inspect re-circulatory pump inlet and rising main outlet and clear when necessary (if provided). Cut submerged and emergent aquatic plants to a maximum of 25% of pond area annually. Remove bank vegetation from water’s edge to a maximum of 25% of pond area annually. Aquatic vegetation arisings should be stacked close to the water’s edge for 48 hours to de-water and allow wildlife to return to the pond. Remove sediment from

25% of pond after 10 years or as required. Inspect and clear inlets and outlets regularly and repair erosion as required. Algae removal may be undertaken for aesthetic purposes during the first 3-5 years of the pond's life. Ponds to be maintained from access roads or open space areas located around the perimeter. Cut grass monthly during growing season and repair erosion at inlets and outlets as required.

Detention Basins: Detention basins will require regular mowing and inspection of each basin inlet/outlet and vegetation and the removal of nuisance plants and rubbish as necessary. Grass should be cut monthly during the growing season and erosion at the inlet/outlet should be repaired as required. Basins can be maintained from the grass strips and access roads along the perimeter.

Geocellular Attenuation Structures: Catch-pits at the inlets and outlets of cellular systems should initially be inspected monthly for 3 months after installation. Thereafter, the system should ideally be inspected twice per year; however, a site specific maintenance schedule should be drawn up using the information obtained from the initial inspections.

If maintenance or cleaning is required, the inspection/maintenance tunnels allow the system to be inspected via a CCTV camera and flushed through. Remove sediment from inlet/outlets and cellular system where required based on inspections.

Bio-swales and Bio-retention Areas: Regularly inspect inlets and outlets, vegetation, mulching and the removal of nuisance plants and rubbish as necessary. Trees and vegetation should be trimmed every 2 years. Swale surface should be spiked, scarified and removed of 'thatch' every 3 years with regular inspection of surface infiltration to avoid areas of ponding. Repair erosion at inlets and outlets and re-turf surfacing as required. Bioretention swales should be maintained from adjacent access roads.

Green Roofs: Most maintenance is usually required in the first three years and should be made the responsibility of the green roof contractor. Intensive green roofs will require regular inspection to prevent litter and debris clogging inlets and interfering with plant growth. Remove dead and nuisance plants as necessary. If erosion occurs, stabilise with additional substrate or 'rip-rap' and source of erosion controlled. All components should be inspected annually or after severe storms including vegetation, substrate, drains, irrigation, inlets and outlets, membranes and roof structure. The underside of the roof should also be inspected for evidence of leakage.

Water butts: Tanks, gutters and ancillaries should be cleaned annually and silt and debris removed. Filters should be replaced as required.

Rainwater Harvesting: In accordance with Manufacturer's guidelines.

Vortex Flow Control Manhole: Normally little maintenance is required as there are no moving parts within a vortex flow control, however, after installation, they should be inspected on a monthly basis for three months to ensure the orifice is not blocked and thereafter at six monthly intervals. They should be hosed down if required and rubbish or debris removed if present. Vortex flow controls should be fitted with a pivoting by-pass door to allow the manhole chamber to be drained down should blockages occur.

Petrol Interceptor: Systems should be visually inspected for every rainfall event for 30 days after installation and the amount of sediment measured to give the operator an idea of the expected rate of deposition. Systems should then be inspected every 6 months to verify the appropriate level of maintenance. Floating debris and solids should be removed and the sump cleaned with a conventional sump vacuum cleaner. Filter media should be replaced and sediments, oils and grease should be removed where required. A log should be maintained detailing the depth of oil found, any oil volume removed and any silt removal or cleaning carried out. Separated light liquid must be removed from the separator when the oil capacity has been reached.

Specific maintenance needs of each SUDS feature should be monitored and maintenance plans and schedules should be adjusted to suit requirements. It is recommended that an annual maintenance report and record is kept by the maintenance contractor, this report should provide the following information:

- Observations resulting from inspections;
- Measured sediment depths where appropriate;
- Results of flow or water quality monitoring, if undertaken;
- Maintenance and operation activities undertaken during the year;
- Recommendations for inspection and maintenance for the following year.

6.3 SUDS Safety

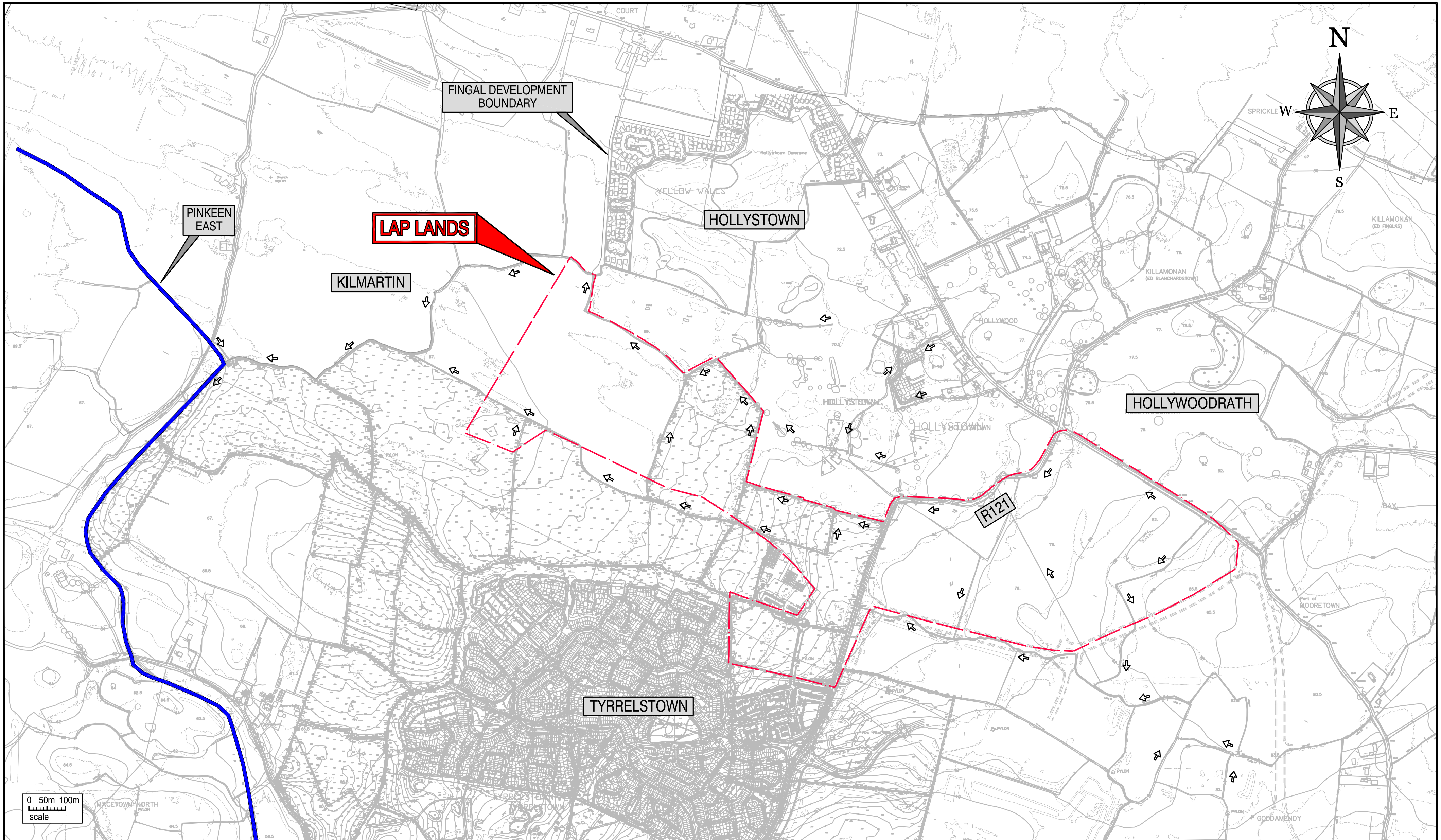
Landscaped detention basins should have a maximum water level of 0.65m in compliance with the SUDS Manual, CIRIA C697Retention ponds should have a maximum depth when flooded less than the 1.2m (4 feet) depth of open water which is recommended internationally (Australia, US).

Embankment slopes for retention ponds and detention basins should be no steeper than 1:4 in compliance with the SuDS manual. A safety bench/maintenance access should be provided by the site access roads which are around the majority of the perimeter of ponds and basins. Swales should have side slopes no steeper than 1:2.

Education boards can be provided to inform the public of the function of the each SuDS features and also provide information on the flora, fauna and biodiversity that the system supports.

APPENDIX A

EXISTING SITE SURVEY



PROJECT KILMARTIN LAP	NOTES 1. DO NOT SCALE FROM THIS DRAWING. 2. SURVEY TO ING CO-ORDINATE SYSTEM. 3. SURVEY TO MALIN HEAD DATUM.		
DRG. TITLE EXISTING SITE SURVEY	ORDNANCE SURVEY IRELAND LICENCE No EN 0017912 © ORDNANCE SURVEY IRELAND GOVERNMENT OF IRELAND		

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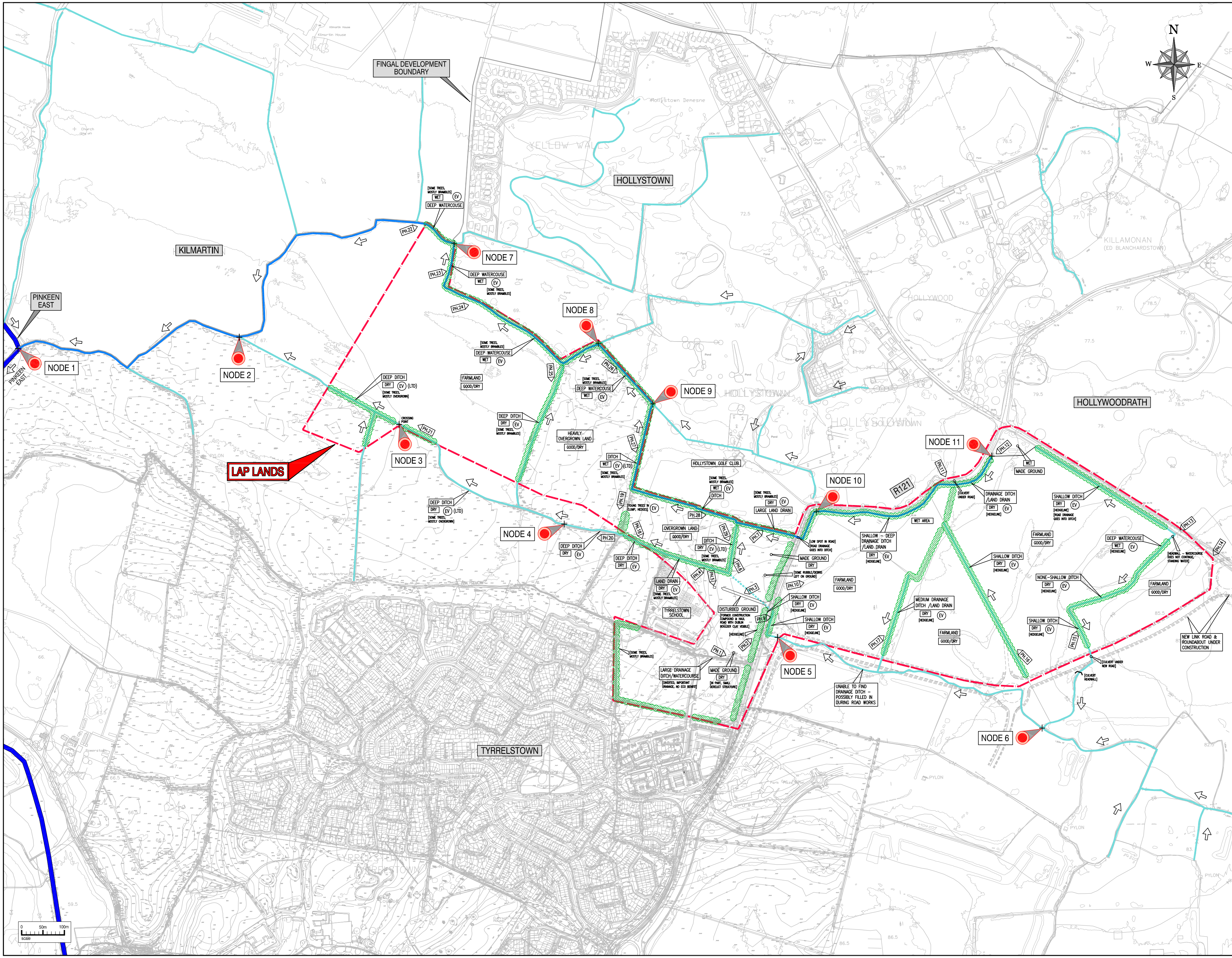
DESIGNED	JBK	PREPARED	KJL'E
DATE	OCT 2012	CHECKED	JBK
CLIENT	Fingal County Council Comhairle Contae Fhine Gall		
SCALE	NTS [A3]	DRG. NO.	123050-9000
FILE REF.	123050-9000		

APPENDIX B

EXISTING LAP DRAINAGE & WATERCOURSES



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ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. SURVEY TO ING CO-ORDINATE SYSTEM.
3. SURVEY TO MALIN HEAD DATUM.

LEGEND:

- EXISTING DRAINAGE DITCH
- EXISTING WATERCOURSE
- PINKEEN EAST
- DIRECTION OF FLOW
- WET — CONTAINS STANDING WATER
- DRY — NO STANDING WATER
- PH.18 — PHOTO NUMBER (REFER TO REPORT)
- TREES/HEDGES/BRAMBLES
- EV — ECOLOGICAL VALUE
- EV (LTD) — LIMITED ECOLOGICAL VALUE
- NODE 1 — EXISTING DITCH NODE
- LAP LANDS
- COUNTY BOUNDARY

ORDNANCE SURVEY IRELAND LICENCE No EN 0017912
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REV.	DATE	DESCRIPTION	BY	CHKD.

LAP

DESIGNED	JBK	PREPARED	KJLE
DATE	OCT 2012	CHECKED	JBK

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PROJECT

KILMARTIN LAP

DRG. TITLE

EXISTING LAP DRAINAGE & WATERCOURSES LAYOUT

CLIENT

Fingal County Council
Comhairle Contae Fhine Gall

SCALE	N.T.S. (A1)	FILE REF.	123050-9020
DRG. NO.	123050-9020		

Photo B1 – Diverted Large Drainage Ditch/Watercourse

Photo B2 – Hedge with No Ditch

Photo B3 – Subsoil Section (following removal of topsoil)

Photo B4 – Tree-lined Field

Photo B5 – No Soakage in Soakpit

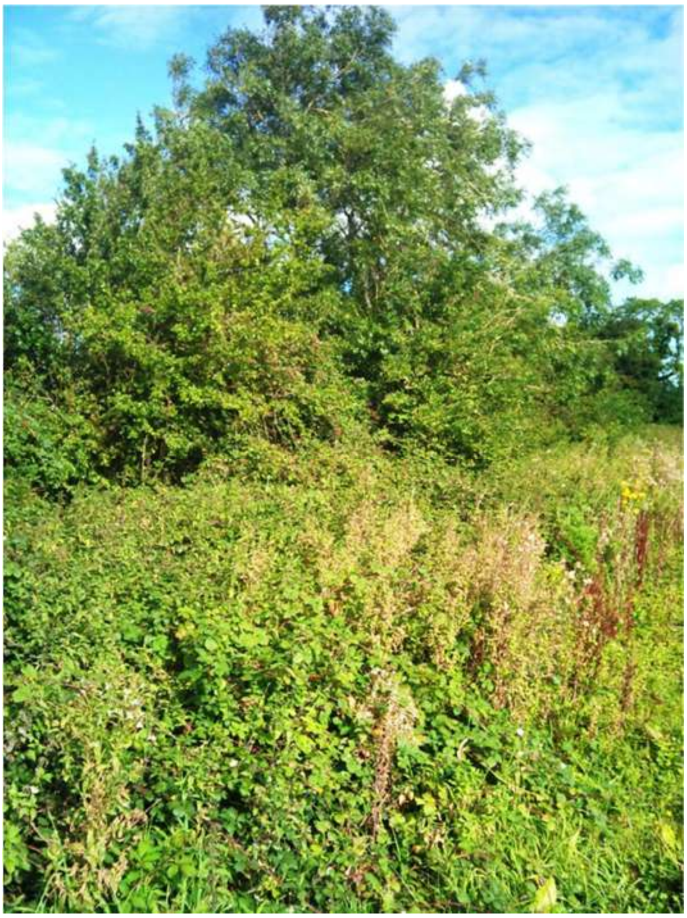


Photo B6 – Tree-lined Field

Photo B7 – Tree-lined Field

Photo B9 – Hedge line/Small Drainage Ditch

Photo B10 – Farmland

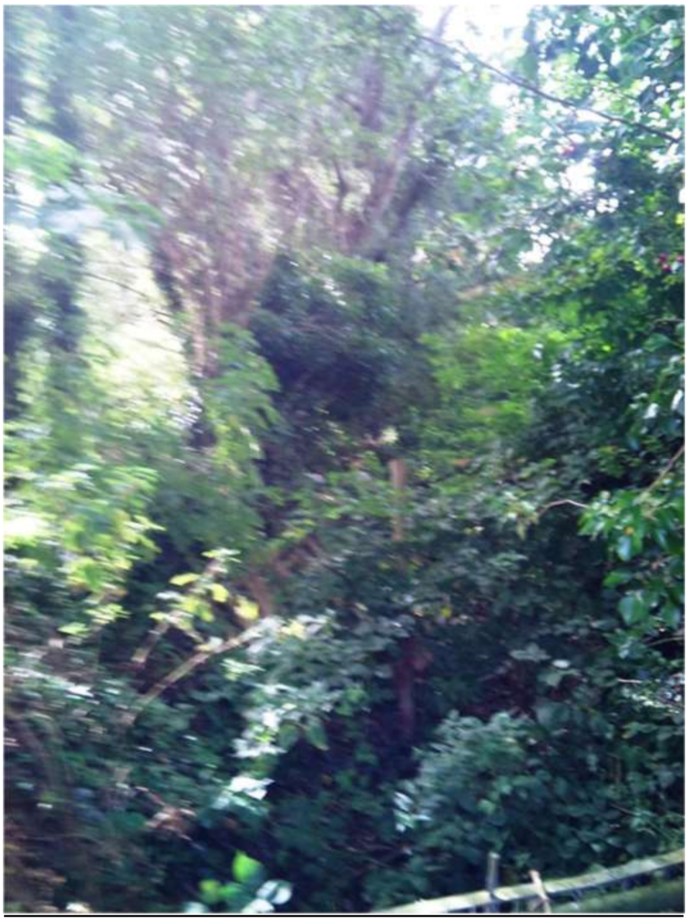


Photo B11 – Drain Culverted Under Road

Photo B12 – Hedge line

Photo B13 – Headwall with Standing Water

Photo B14 – New Roundabout & Link Road Under Construction

Photo B15 – Hedge line

Photo B16 – Hedge line/Shallow Drainage Ditch

Photo B17 – Hedge line/Land Drain

Photo 18 – Hedge line/Deep Drainage Ditch

Photo B20 – Young Trees in Clump

Photo B20 – Hedge line/Deep Drainage Ditch

Photo B21 – Not Many Trees/Deep Drainage Ditch

Photo B22 – Tree line/Deep Watercourse

Photo B23 – Tree line/Deep Watercourse

Photo B24 – Tree line/Deep Watercourse

Photo B25 – Tree line/Deep Drainage Ditch

Photo B26 – Tree line/Deep Watercourse

Photo B27 – Some Trees & Brambles/Wet Drainage Ditch

Photo B28 – Some Trees & Brambles/Wet Drainage Ditch

Photo B27 – Some Trees & Brambles/Dry Drainage Ditch

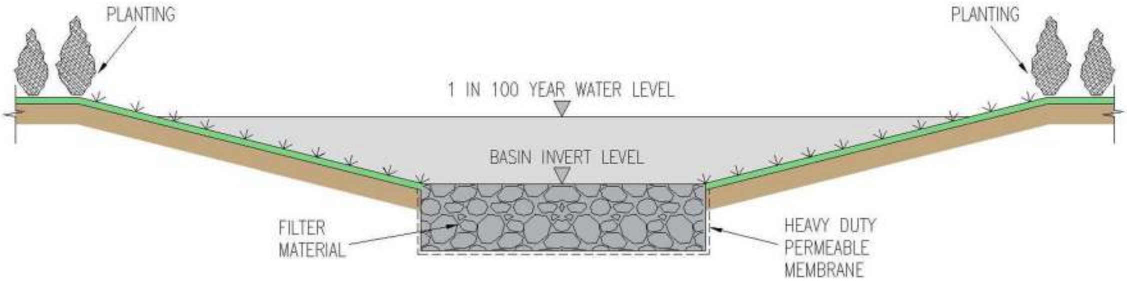
Photo of Pinkeen East

APPENDIX C

GENERAL SUDS DETAILS

Detention Basin

Typical Detention Basin

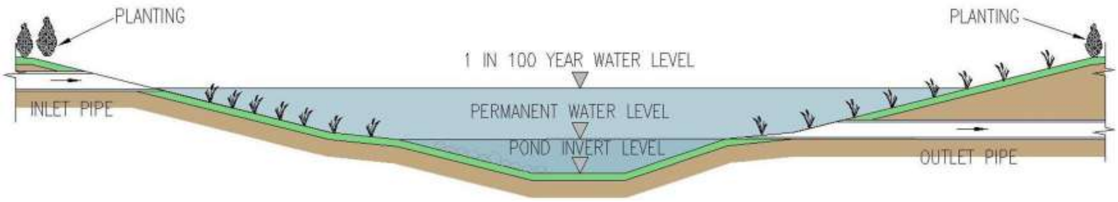


Detention Basin - Schematic

Description:
A normally dry vegetated surface depression which provides flow control through attenuation of storm-water runoff. Detention basins can provide water quality treatment and amenity or can be constructed to serve more than one purpose such as car-park, playground or sports fields.

Retention Pond

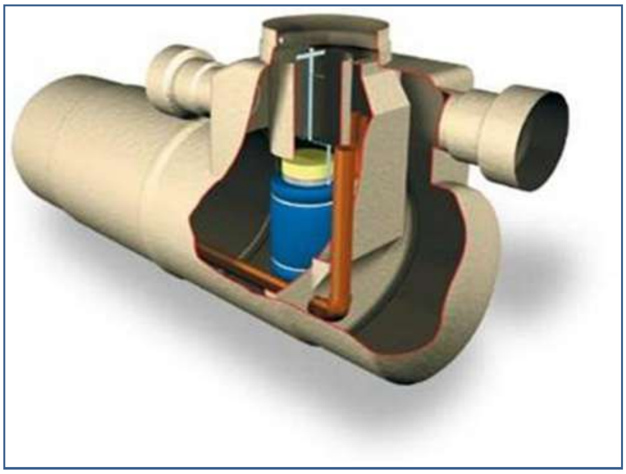
Typical Retention Pond



Retention Pond - Schematic

Description:
A landscaped storage basin with a permanent pool of water providing aesthetic value, amenity, wildlife and biodiversity opportunities and also water quality treatment. Ponds allow temporary storage of additional storm-water runoff above the permanent water level for attenuation of extreme rainfall events.

Petrol Interceptor

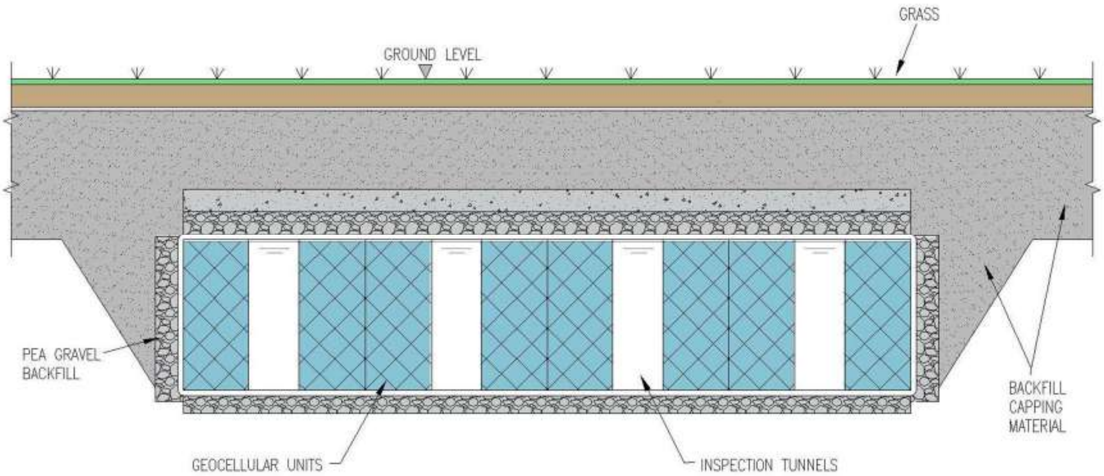


Typical Petrol Interceptor

Description:
Proprietary GRP oil/water separators which prevent hazardous chemical and petroleum products from entering watercourses and public sewers.

Geocellular Attenuation System

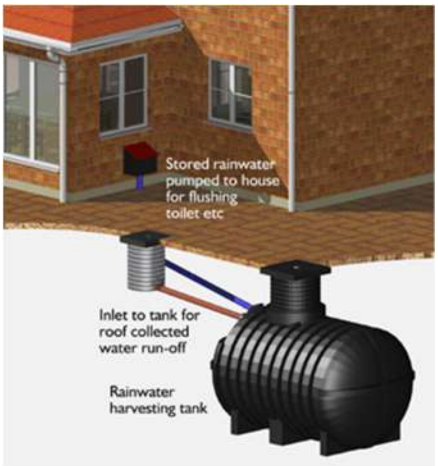
Typical Geocellular System



Geocellular System - Schematic

Description:
Proprietary plastic modular block or arch structures with maintenance/inspection tunnels for providing underground surface water attenuation storage. Storm-water run-off infiltrates to the ground through the base of the system where the subgrade is suitable.

Rainwater Harvesting System

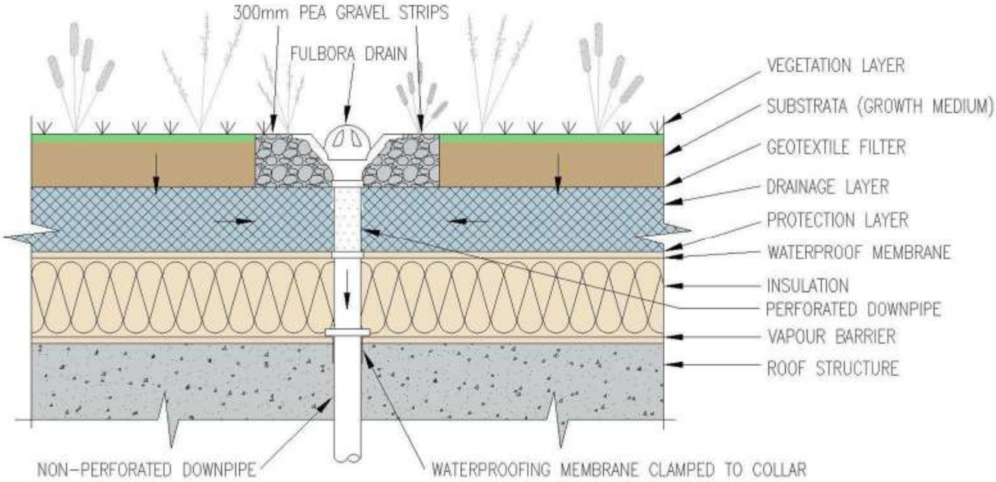


Typical Rainwater Harvesting System

Description:
Underground GRP tank with built in pump system which collects rainwater from roofs which is stored and re-used for grey-water usage (toilets, washing machines etc.) or landscaping usage.

Green Roof

Typical Extensive Green Roof



Extensive Green Roof - Schematic

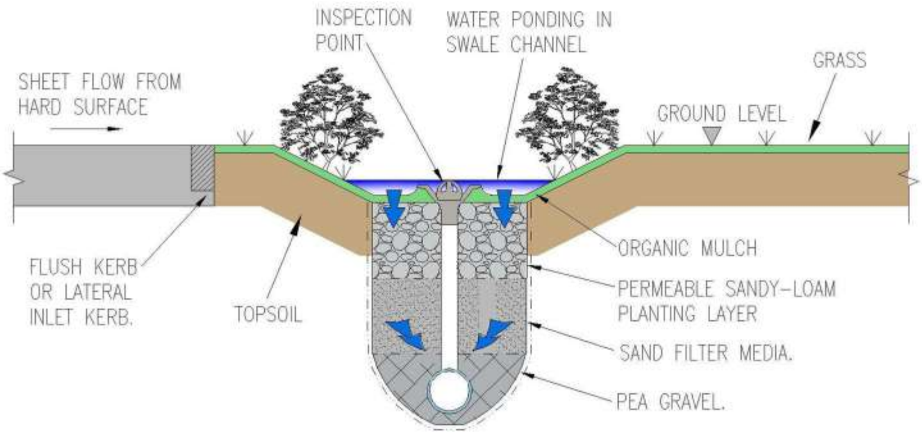
Description:

Green roofs provide ecological, aesthetic and amenity benefits and intercept and retain rainfall, at source, reducing the volume of runoff and attenuating peak flows. Green roofs absorb most of the rainfall that they receive during ordinary events although they will only contribute to attenuation of flows for larger events. Additionally, green roofs treat surface water through removal of atmospherically deposited urban pollutants. Finally, green roofs may reduce heating (by adding mass and thermal resistance value) and cooling (by evaporative cooling) loads on a building.

An extensive green roof consists of a planted roof area with low growing, low maintenance plants consisting of self-sustaining mosses, sedums, succulents, herbs or grasses over a drainage layer and waterproofing membrane. Extensive roofs are usually only accessed for maintenance.

Bio-retention Swales

Typical Bio-retention Swale



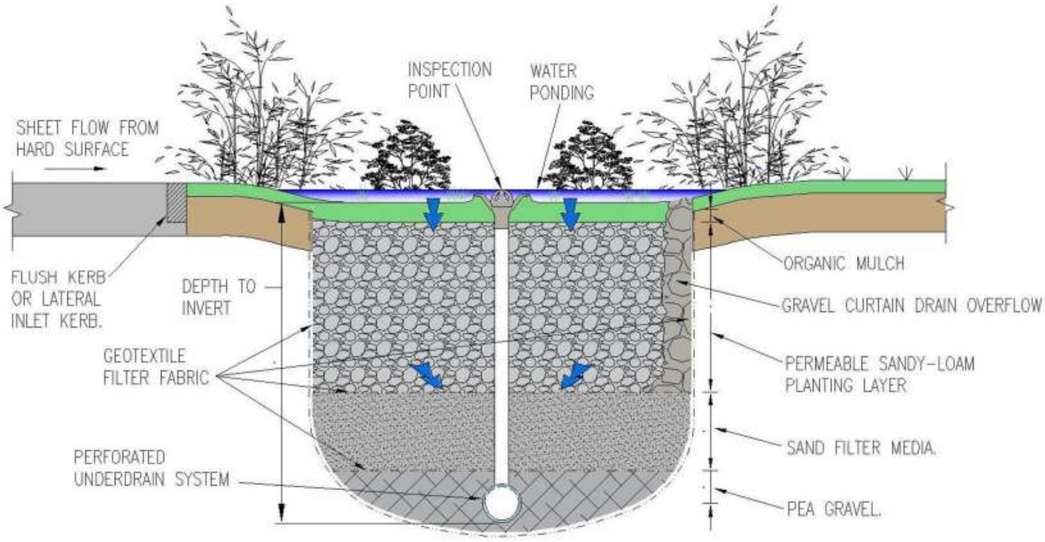
Bio-retention Swale - Schematic

Description:

A shallow landscaped channel adjacent to roads and paved areas with enhanced vegetation and planting on the surface to manage and treat runoff, at source, and promote biodiversity development. These systems allow runoff to be collected in through inlet kerbs and are located adjacent to roads and hard-standing areas.

Bio-retention Areas

Typical Bio-retention Area



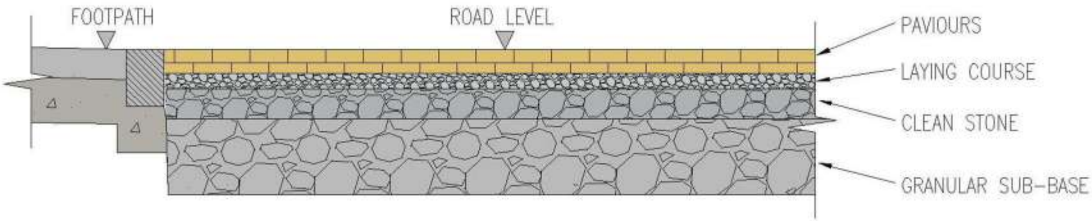
Bio-retention Area - Schematic

Description:

A shallow landscaped depression which is under-drained with engineered soils and enhanced vegetation and planting on the surface to manage and treat runoff, at source, and promote biodiversity development. These are located adjacent to roads and hard-standing areas.

Permeable Paving

Typical Permeable Paving



Permeable Paving - Schematic

Description:

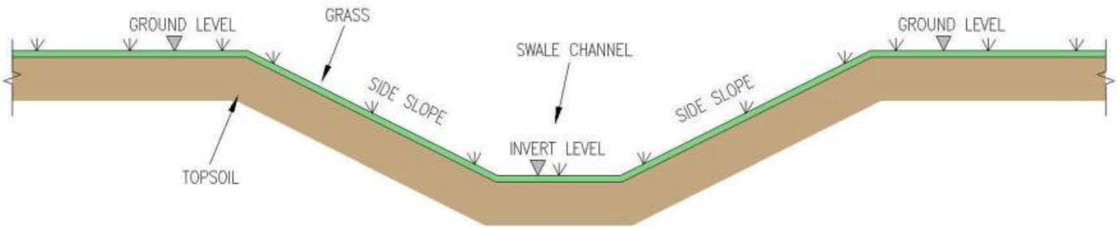
Porous surfacing (paving block or open graded material) which can treat rainwater, at source, and allow infiltration through to an underlying porous sub-base where water can be stored within the voids of the sub-base before being slowly released through natural flow via the porous medium.

A tanked permeable paving system includes an impermeable geotextile at its base. These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities; therefore there will be less run-off from these areas in small rainfall events thus mimicking the natural response for this catchment.

As well as reducing the amount of run-off from the surface, permeable paving will slow down the rate of runoff from the pavement in extreme rainfall events contributing to attenuation of flows. In addition, permeable paving will increase the quality of water which is intercepted by the system through filtration, biodegradation, pollutant adsorption and settlement and retention of solids, also the reduction in peak flows to the outfall will enhance settlement and biodegradation of pollutants.

Swales

Typical Swale

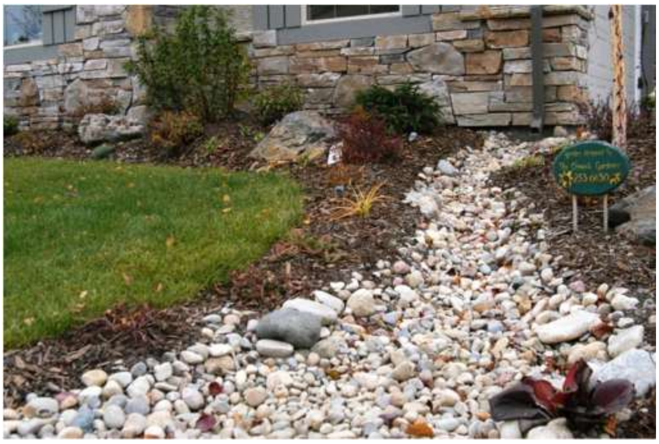


Swale - Schematic

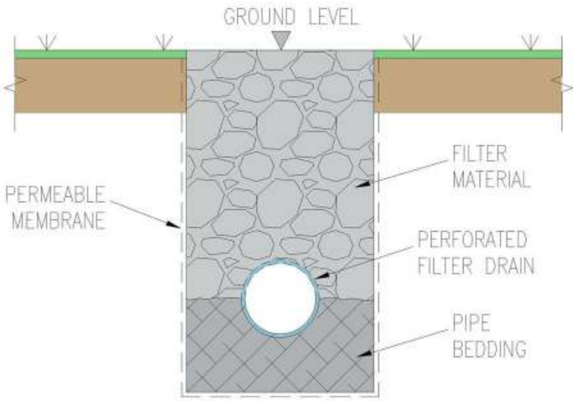
Description:

A broad, shallow drainage channel covered in grass which can treat, convey and attenuate runoff, at source, and can infiltrate to the ground where the subgrade is suitable. Swales also can promote biodiversity. Dry swales are similar to wet swales but are under-drained by a filter drain. Swales are located adjacent to roads and hard-standing areas and in open space areas.

Filter Drain



Typical Filter Drain



Filter Drain - Schematic

Description:

Trenches filled with permeable material and a perforated collection pipe at the invert with an optional permeable ‘sandy’ topsoil at surface. These can treat, convey and attenuate runoff, at source, and can infiltrate to the ground where the subgrade is suitable. These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less run-off from these areas in small rainfall events thus mimicking the natural response for this catchment.

Filter Strip

Typical Filter Strip

Description:
Wide, gently sloping areas of grass which treat runoff from adjacent impermeable areas and roofs, at source, running over its surface. Filter strips also have an attenuating effect on runoff and can allow some infiltration to the ground where the subgrade is suitable. These are located adjacent to hard-standing areas.

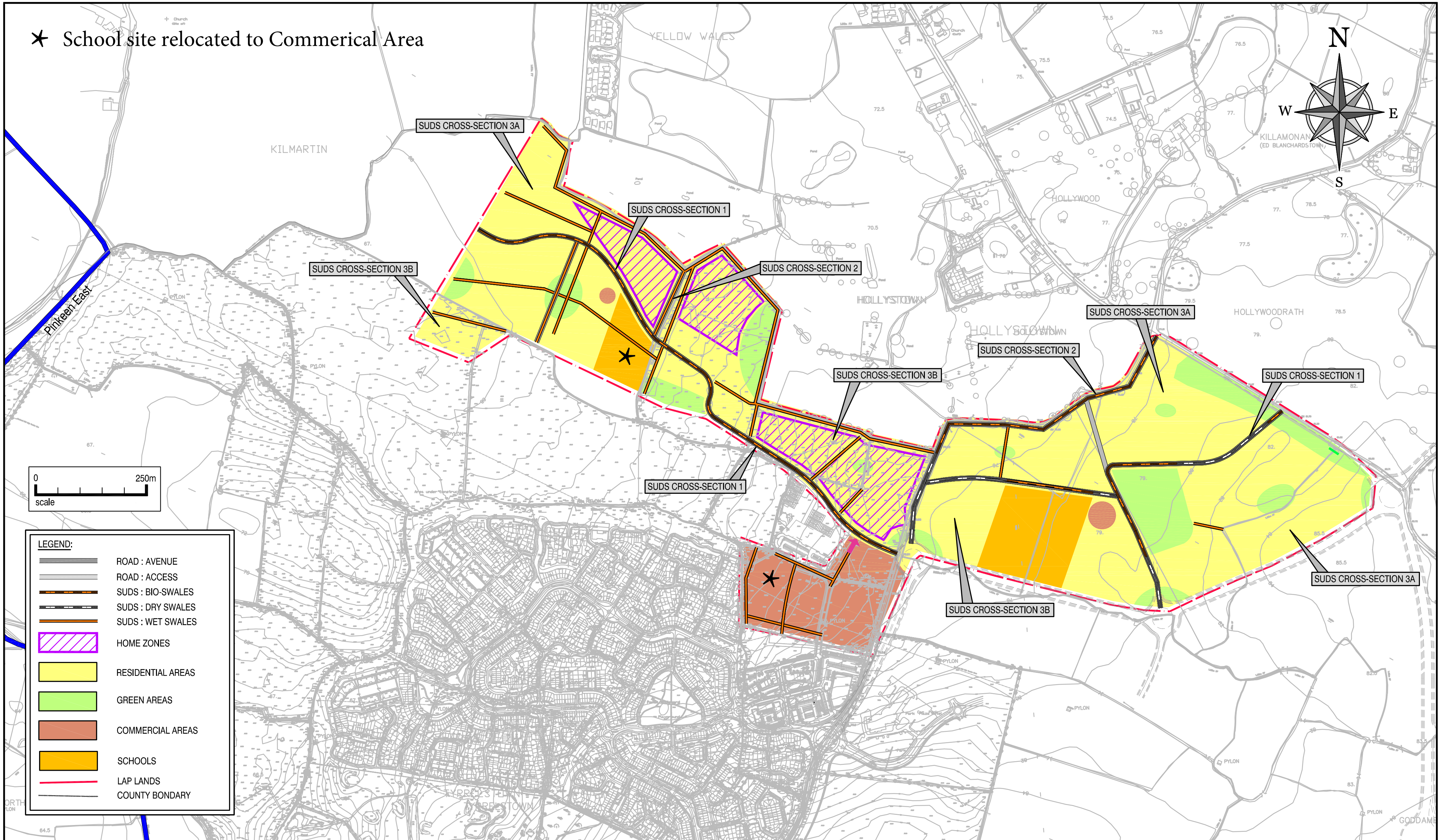
Rainwater Butt

Typical Rainwater Butt

Description:
Rainwater from roof downpipes can be collected in a rainwater tank or barrel to be stored and re-used for landscaping or car-washing usage. Butts are proposed in every back-garden.

APPENDIX D

LOCATIONS OF SUDS CROSS-SECTIONS



PROJECT

KILMARTIN LAP

DRG. TITLE

SUDS LOCATION PLAN

NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. SURVEY TO ING CO-ORDINATE SYSTEM.
3. SURVEY TO MALIN HEAD DATUM.

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DESIGNED	JBK	PREPARED	KJL'E
DATE	OCT 2012	CHECKED	JBK

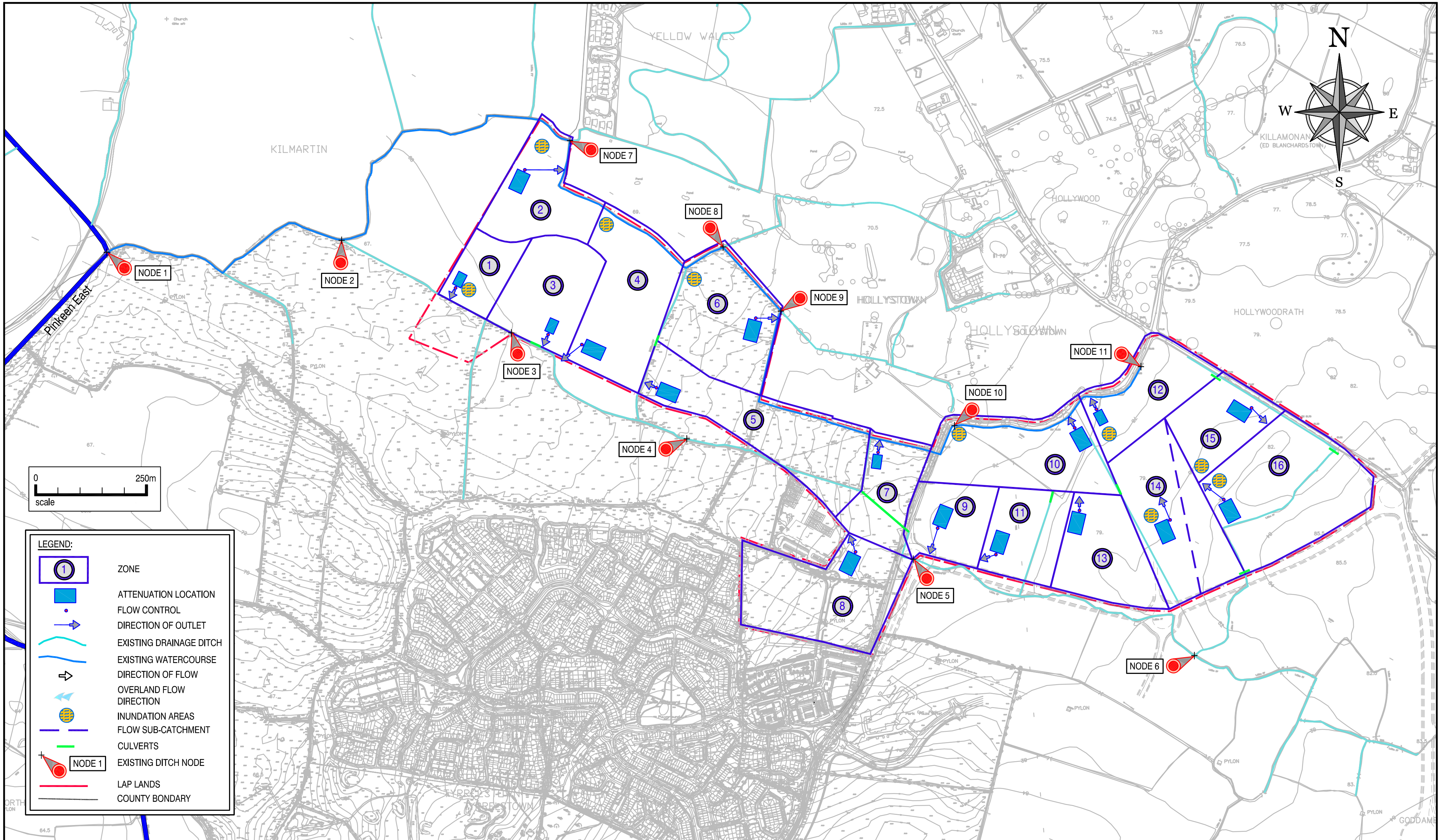
CLIENT

Fingal County Council
Comhairle Contae Fhine Gall

SCALE	NTS [A3]	DRG. NO.	123050-9030
FILE REF.	123050-9030		

APPENDIX E

SUDS STRATEGY & ATTENUATION PLAN



PROJECT

KILMARTIN LAP

DRG. TITLE

ATTENUATION PLAN

NOTES

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3. SURVEY TO MALIN HEAD DATUM.

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DESIGNED	JBK	PREPARED	KJL'E
DATE	OCT 2012	CHECKED	JBK

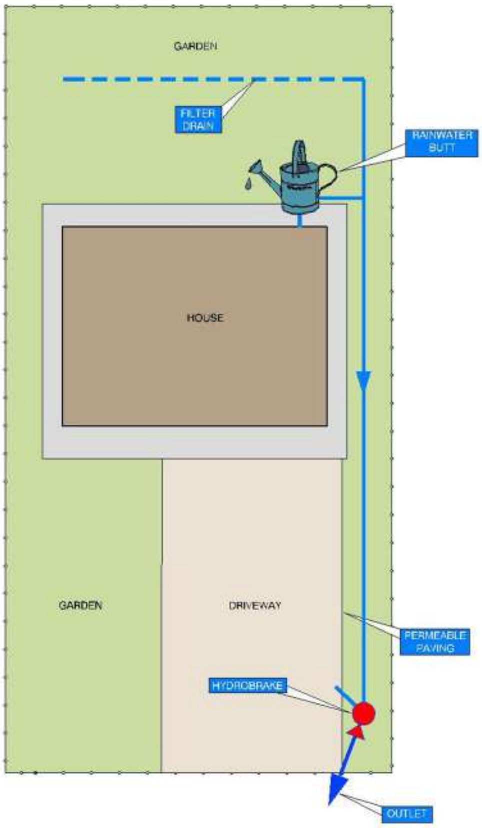
CLIENT

Fingal County Council
Comhairle Contae Fhine Gall

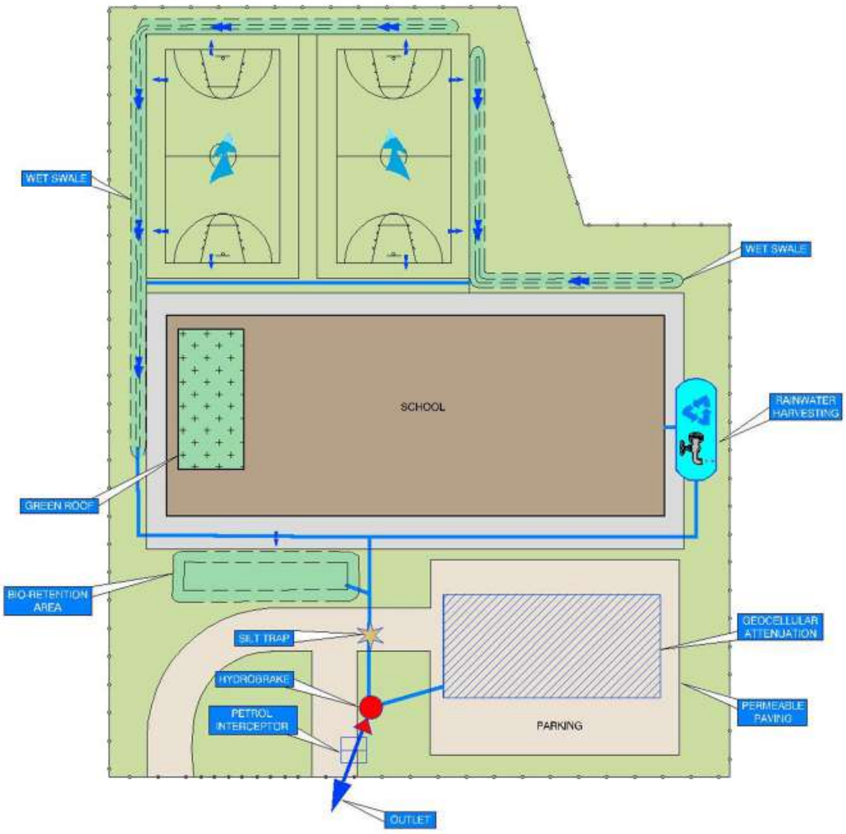
SCALE	NTS [A3]	DRG. NO.	123050-9010
FILE REF.	123050-9010		

APPENDIX F

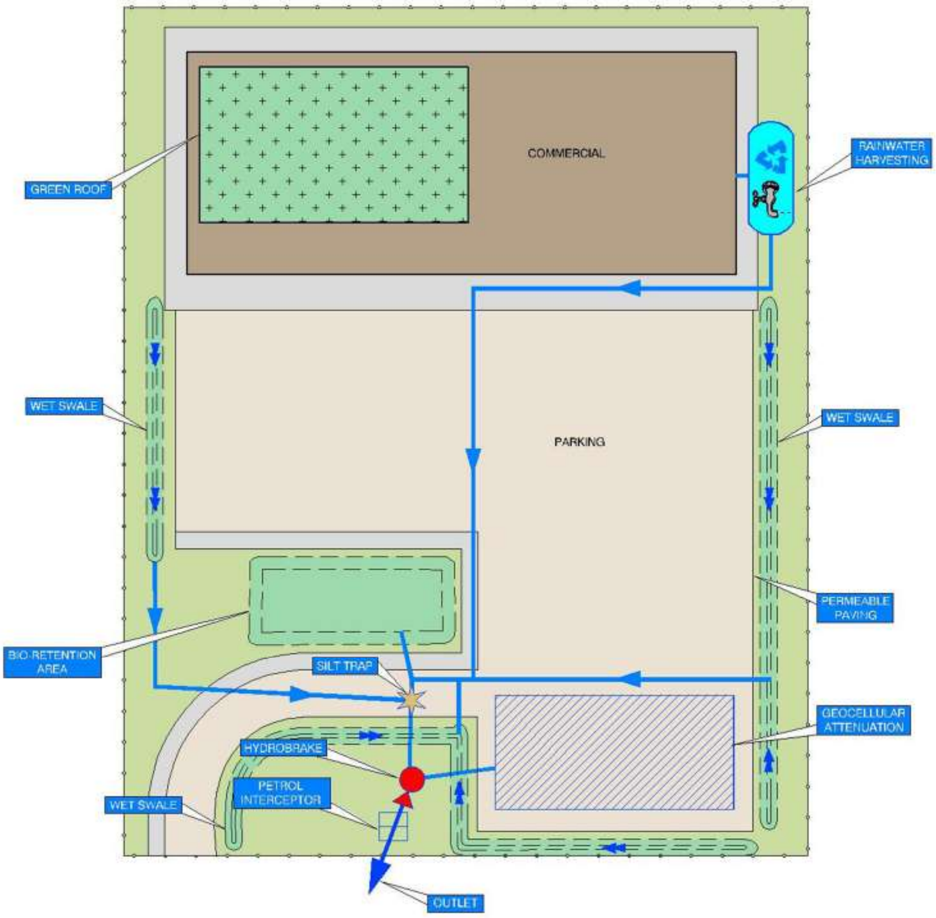
TYPICAL RESIDENTIAL, COMMERICAL AND EDUCATIONAL LAYOUT



TYPICAL HOUSE LAYOUT



TYPICAL SCHOOL LAYOUT



TYPICAL COMMERCIAL LAYOUT

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